REMARKS

This is in response to the Office Action of December 12, 2003. Please cancel claims 2-7, 18, and 21-24 without prejudice. Claims 1, 8-13, 15-17, 19, and 20 were amended. New claims 25-43 were added. Claims 1, 8-17, 19-20, and 25-43 are pending.

The Examiner rejected claims 1-2 under 35 U.S.C. 102 over Kikuchi et al (U.S. Pat. No. 6,142,680). Claims 1, 3, and 4 were rejected under 35 U.S.C. 103 over Nguyen et al. (U.S. Pat. No. 6,624,507). Claims 2 and 5-24 were rejected under 35 U.S.C. 103 over Nguyen in view of Kikuchi.

Applicant has amended claim 1 to include the limitations of claims 2-7 and to clarify that the beams are collimated along the coaxial portion of the optical paths. Applicant has also amended claim 1 to clarify that the optical fiber connection unit includes a collimating lens unit, which is supported by original claim 17. Dependent claims 8, 9, 10, 11, 12, 13 15, 16, 17, 19, and 20 were amended to be in accordance with the changes to claim 1.

Applicant has also added new claims 25-43 to clarify functional relationships that facilitate fine alignment of optical components. New claims 25-43 are supported by the original claims and also include additional limitations describing the collimating beams that are supported in paragraphs [0045]-[0048] and elsewhere in Applicant's specification.

Independent claims 1, 25, 36, and 42 include a limitation that the outgoing beam generated by the optical signal generating unit is redirected by a mirror towards the fiber connection unit and that the incoming beam is redirected by a mirror towards the optical signal receiving unit. One benefit of Applicant's claimed invention is that it permits a closely spaced arrangement of a light source and detector that is highly manufacturable.

Independent claims 1 and 25 also include limitations corresponding to collimated incoming and outgoing beams coupled to a single optical fiber. The collimation of the incoming and outgoing beams facilitates independent fine alignment of components during assembly of the optical module. As described in paragraph [0048], conventional optical modules tend to have converging and diverging beams such that any adjustment of the optical alignment requires adjusting the position of all of the optical elements. In

contrast, Applicant's claimed invention permits independent fine adjustment of individual components because the beams remain collimated irrespective of the relative movements between the elements, as described, for example, in paragraphs [0045] and [0048]. Thus, for example, a pre-assembled optical fiber connection unit, laser diode, and detector can be adjusted essentially independently of each other during fine alignment.

Additionally, independent claims 1 and 25 and dependent claims 37 and 43 include a limitation that the optical fiber connection is a single unit that includes a collimating lens unit coupling light to a fiber. The optical axis of the optical fiber collimating lens is, by virtue of the pre-assembly process, fixed in alignment to the optical fiber, as described in paragraph [0041]. As a result, no alignment of the second collimating lens unit to the optical fiber is required during assembly of the optical module.

Kikuchi (U.S. Pat. No. 6,142,680) has an optical geometry that is fundamentally different from Applicant's claimed invention and fails to teach or suggest a number of structural and functional relationships.

The optical module of Kikuchi does not have a first mirror that redirects an emission of a laser diode towards an optical fiber, as required by independent claims 1, 25, 36, and 42. Kikuchi utilizes two mirrors 5 and 15 to redirect incoming light into a photodiode 9. However, the optical module of Kikushi has no mirror deflection of the outgoing laser diode light. Light from a laser diode 6 is directed straight towards an optical fiber 12. Note that light generated by laser diode 6 passes through partial wave filter 5, as described in column 4, lines 27-30. Thus, there is no redirection of the outgoing laser light by a mirror in Kikuchi.

The optical module of Kikuchi does not have an optical fiber connection unit that includes a collimating lens held in optical alignment with an optical fiber, as required by independent claims 1 and 25 and dependent claims 37 and 43. Kikuchi has a lens holder 14 disposed within the housing 20 of Kikuchi whereas an optical fiber holder is attached to housing 20. Thus, in Kikuchi the lens and the optical fiber holder are separate components, not a single unit held in optical alignment as in Applicant's claimed invention.

Applicant also respectfully submits that Kikuchi does not teach or suggest features for collimating incoming and outgoing beams through at least part of the length of an optical axis of an optical module in the manner of claims 1 and 25. Kikuchi includes passages P1, P2 and P3 for guiding light, as described in column 4, lines 26-34. Passages P1 and P2 are described as guiding outgoing light whereas passages P2 and P3 are described as guiding incoming light, as described in column 4, lines 26-34. This description of the passages P1, P2, and P3 as guiding the incoming and outgoing beams implies that the beams interact with the walls of the passages and is therefore inconsistent with collimated beams.

In regards to independent claim 25, Kikuchi does not have the combination of features that provides the function of permitting independent alignment of optical components. For example, column 4, lines 35-54 of Kikuchi describes an assembly procedure in which the optical axis of the optical fiber is first adjusted, the partial wave filter 5 and optical fiber lens 13 set, and the fiber affixed to the housing by welding. After the fiber is affixed to the housing, the lens holder 11 of the detector and the reflecting mirror 15 are affixed to the housing. Then the optical axis of the photodiode is adjusted, after which the photodiode 9 is affixed to the housing. Note that Kikuchi teaches performing alignment in a sequence of steps in which an emitter portion of the optical module is aligned and components welded into place before moving on, progressively, to align and affix the detector portion of the optical module. This assembly method is clearly contrary to independent fine adjustment of the laser diode, optical detector, and optical fiber.

Applicant respectfully submits that Nguyen teaches away from a coaxial geometry in which incoming and outgoing beams are coupled to a single fiber, as required by claims 1, 25, 36, and 42. The Examiner stated that it is not clear whether the embodiment of Figure 4b of Nguyen has optical signal generating and receiving units arranged to receive and transmit signals into a single fiber. Applicant disagrees. Nguyen clearly teaches an optical module design in which the detector receives light from one optical fiber and the laser diode transmits light from a second optical fiber, as illustrated in Figure 3A, which shows an emitter 306 coupled to a first fiber and a detector coupled

to a second fiber, as described in column 4, lines 27-30. Nguyen in Column 6, lines 1-4 describes the embodiment of FIG. 4 as having "optical fibers 416" (plural) "an emitter 410" (singular) and "an optical detector 412" (singular) with "Mirrors 414 . . . positioned to reflect light signals to and from the optical fibers 416." A comparison of Figure 4A with Figures 7-8 clearly shows that the mirrors 414, emitter 410, and detector 412 are arranged in a non-coaxial two-fiber configuration. FIG. 7 shows a module with two fibers 416. The cross-sectional view of the module is shown in FIG. 8 looking into a direction towards the two fibers 416. As can be clearly seen in Figure 8, the two mirrors 414 are spaced apart across the width of the module in a non-coaxial configuration. Each optical fiber is coupled to only one of the opto-electronic components (i.e., either the emitter or the detector) by one mirror 414. Applicant thus respectfully submits that Nguyen, when read as a whole, clearly indicates that the embodiment of Figures 4A and 4B has a non-coaxial configuration with two optical fibers, one for an emitter and one for a detector.

The Examiner contends that even if Nguyen utilizes separate optical fibers for the emitter and optical detector that that it would be obvious to modify the two-fiber optical module of Nguyen into a coaxial single fiber configuration. Applicant respectfully disagrees. There is no teaching or suggestion in Nguyen to perform this modification. Moreover, an optical module with two optical fibers, each dedicated to a separate opto-electronic component, is a well-known design that provides the benefit of simple optical fabrication, complete optical isolation of the receiver from the transmitter, and trivial optical alignment of opto-electronic components. For example, with separate optical fibers, the optical alignment of the emitter to its optical fiber can be performed completely independently from the process used to align the optical detector to the other fiber.

In regards to independent claims 1 and 25 and dependent claims 37 and 43, Nguyen does not have an optical fiber connection unit that includes a collimating lens unit as required by Applicant's claimed invention. Nguyen illustrates optical fibers 416 attached to a side of housing 408. There is no optical fiber connection unit in the optical module of Nguyen. No lens unit of any kind is taught in Nguyen.

In regards to independent claims 1 and 25, there is no collimating lens unit in Nguyen for collimating the laser diode emission. As previously described, the optical module of Nguyen has no optical lens units of any kind.

Nguyen also does not teach or suggest collimating incoming or outgoing beams. As previously described, there are no lens units in Nguyen. Moreover, there is no teaching or suggestion for collimating incoming or outgoing beams in Nguyen.

Applicant respectfully submits that one of ordinary skill in the art would not be motivated to combine Nguyen and Kikuchi to achieve any of Applicant's claimed inventions. The optical module of Kikuchi has a configuration that uses two mirrors to deflect incoming laser light but has no deflection of outgoing laser diode light. Nguyen has a non-coaxial geometry that utilizes two separate optical fibers, one fiber for an emitter and another fiber for an optical detector. Neither reference teaches or suggests redirecting both incoming and outgoing beams to be coaxial with an optical fiber. Neither reference teaches or suggests forming collimated beams. Neither reference teaches an optical fiber connection unit having a collimating lens unit.

Additionally, neither reference is directed to the problem of facilitating independent fine alignment of optical components in a coaxial single-fiber configuration. Kikuchi has a multi-step alignment process in which the emitter portion of the module is first aligned and then fixed into place before the detector portion is aligned. Nguyen has separate fibers for the emitter and detector. Neither reference provides a teaching or suggestion for a single fiber design that facilitates independent fine alignment of an emitter, detector, and optical fiber connection unit.

The dependent claims are allowable for at least the same reasons and also include additional limitations. In view of the foregoing amendments and remarks, it is respectfully submitted that the application is now in condition for allowance. The Examiner is invited to contact the undersigned if there are any residual issues that can be resolved through a telephone call.

The Commissioner is hereby authorized to charge any appropriate fees to Deposit Account No. 03-3117.

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Respectfully submitted,
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